

Focused Ion Beam Systems Advance Technology at Manufacturing Science & Technology Center

A second focused ion beam (FIB) system has been brought to 14100 for continued research and development of microscale and nanoscale fabrication techniques. Installation is nearly complete and by the time this article is published, a second tightly focused beam of atoms will be bombarding some of the hardest materials known.

FIB systems precisely remove material from a solid object by ion bombardment. A focused beam of gallium can be guided to trace simple or complex geometric patterns, and may also be controlled in position and

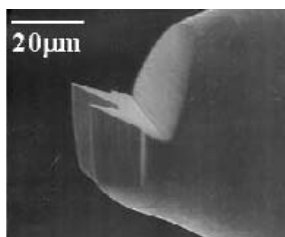


Fig. 1. Two prong turning tool made of high speed steel

time to cut three-dimensional shapes. The material removal process does not heat the object being shaped and there are no large forces on the sample during ion shaping. The object that is being sculpted is observed during manufacture, and the process can be altered if needed.

The ion beam manufacture of microscale machine tools is a target application. This idea developed from a desire to prototype micro-structures using machining techniques, rather than lithographic methods. Precision machining currently plays a vital part in several Sandia and DOE missions. In particular, those involved with high-density plasma experiments at the National Ignition Facility rely on precision machining to

“Techniques have been developed at Sandia that establish cutting edge radii of curvature equal to 40 nanometers. . . A recent advance allows the focused ion beam system to perform like an atomic beam lathe.”

Techniques have been developed at Sandia that establish cutting edge radii of curvature equal to 40 nanometers.

The apparatus is not limited to the fabrication of cutting tools. A recent advance allows the focused ion beam system to perform like an atomic beam lathe. The beam is directed toward a coated cylindrical substrate (such as a tube) and material is sputtered off around the circumference of the cylinder to form a helix or other shape (see Figs. 2 & 3). This has led to the fabrication of microcoils having diameters as small as 125 microns for use in sensors.

Current and past team members include: David Adams, Michael Vasile,

custom fabricate curvilinear shapes in exotic materials. Focused ion beam technology will aid this program by shaping custom, micron-size machine tools in materials such as diamond and tool steel (see Fig. 1).

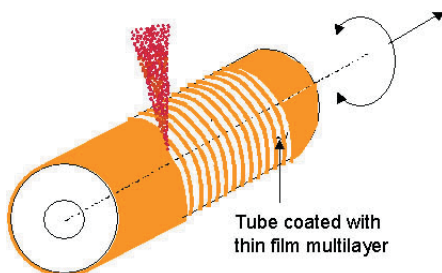


Fig. 2. Focused ion beam lathe process for fabricating microscale coils.

Carter Hodges, Gil Benavides, Yoosuf Picard, Tom Mayer, Henry Apodaca, M. Barry Ritchey and others.

Contact David Adams (505-844-2754, dpadams@sandia.gov)

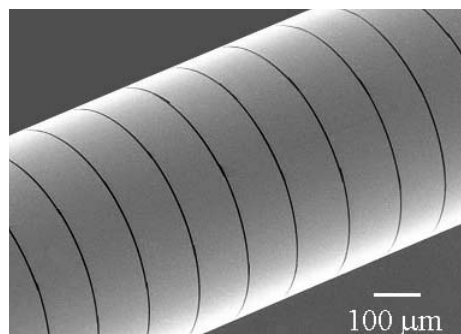


Fig. 3. FIB sputtered microcoil. Regions that appear dark have been bombarded to remove a Cr/Au thin film from a glass substrate.

Environmental Excellence

The Mfg. S&T Center is committed to environmental excellence. The Center made this commitment because environmental excellence also improves efficiency and saves money. Since an important part of this commitment is employee involvement, employees are encouraged to participate in activities that can reduce any environmental impact in the Center's operations.

To this end, the Center is working on the following initiatives:

Pollution Prevention Opportunity Assessment:

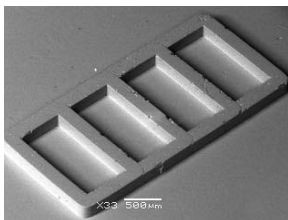
Kristin Klossner, Pollution Prevention Specialist from Hazardous and Solid Waste Pollution Prevention, will be conducting this assessment for the entire Center. She will evaluate all processes that generate hazardous waste and develop cost-effective waste reduction strategies. She is asking for your ideas that reduce hazardous waste. She will do a cost-benefit analysis to determine their feasibility and practicality. Kristin will be

(Excellence, continued on page 4)

Tech Updates

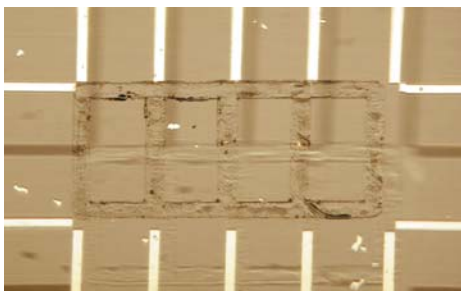
Formation of Patterned Thin Films of Organic Materials

Using traditional dispensing techniques to form patterned organic films with micron-scale resolution is very difficult to do. Ink jet printing, for example, is often limited to aqueous solutions, because of materials compatibility issues in the ink jet device itself.



Elastomeric stamp used to print patterned film of organic material.

Most polymers, however, are soluble only in more aggressive organic solvents. A technical advance, "Formation of patterned thin films of organic materials," recently filed by Rachel Giunta, David W. Peterson and Chris J. Rondeau, describes a technique for directly patterning organic films using a microstamping technique.



Patterned film of polymer on a glass microscope slide. Shadowed image is a reflection of the stamped film and the metallized alignment marks on the back side of the microscope slide.

Similar to a technique developed by Whitesides, et al. at Harvard, this technique uses a silicone stamp with micron-scale features to directly pattern films of organic materials. The method is analogous to using a rubber stamp to print with ink on paper. Applications include direct-printing of circuits using conductive polymers, and formation of organic films for surface acoustic wave (SAW) devices on microsensors such as μ ChemLab.

Contact Rachel Giunta (505-844-9212, rgiunta@sandia.gov)

Research & Development (R&D) 100 Award

SNL and EMCORE received a 2002 R&D 100 Award from R&D Magazine in honor of their recent invention of the MTR8500 Very Short Reach OC-192 Parallel Array Transponder Module. Currently, over 75% of all fiber optic data interconnects are less than 200 meters long. This module uses a new method of fiber optic interconnection based on state-of-the-art optoelectronic microsystem technology that enables the cost of these relatively short interconnects to be reduced by a factor of 4 to 10. The MTR8500 is the first, and at this time, only commercially available OC-192 transponder product to use 12-channel 1.25 gigabit per second transceivers coupled to standard multi-mode 12-fiber ribbon cable for VSR-1 short haul implementation.

Several researchers in Mfg S&T worked to develop a manufacturing process for connecting optical components and then transferred the technology to EMCORE for production. This application required a material that was transparent at 850 nm, offered high strength adhesion, and was chemically compatible with the die surface. The researchers developed a manufacturable process to enable reproducible precision alignment of 12 channels to micron tolerances for the transponder. The researchers also developed manufacturing processes to encapsulate the optical components and to assemble a flex circuit to a heat sink. For all processes, speed, cost, and the ability to automate were critical to the product's success. Researchers from the Center included Rachel Giunta, Terrence Smith, and Merideth Rising--now in the Materials and Process and Sciences Center.

Contact Carla Chirigos (505-845-8645, cdchiri@sandia.gov)



Rachel Giunta



Terrence Smith



Merideth Rising

Upgraded Cable Tester

The Mfg S&T Center's custom-built cable tester can do 100 conductor, 4-wire resistance measurements, using an external current source for accuracy into the milliohms. The tester can also check for insulation breakdown, with up to 1000 volts applied to the cable under test.

Furthermore, it can test a cable with no documentation and determine its connection points. It can determine the conductor size to verify whether the cable was fabricated with the proper wiring size.

Because it also has adapters that connect to most mil-spec connectors, it can perform the tests in separate steps—and therefore can test cables with unlimited branches and more than 100 conductors.

Software upgrades now in progress will allow it to save the data files electronically. These new files will eliminate the current manual process of entering data for each

pre-pot and post-pot test. They will also give the Center an electronic archive.

Once the Center has these new files, the cable data will be in a table format, likewise eliminating the need for manual input. The Center will then test the time it takes to scan the cable and determine the connectivity through the tester. The new files would allow the Center to (a) quickly verify the connectivity data by comparing it to the drawing, and (b) accept the date if it is correct.

If the new scanning method is not too lengthy, the Center would prefer it to the current method of determining test parameters. Not only would the new method completely eliminate manual input of data for cables that have no electronic data files, but it would also eliminate the human errors associated with manually inputting data.

Contact Debbie Rimbart (845-9557, dlrimbe@sandia.gov)

Laser Machining

The laser is a 2500-Watt CO2 laser capable of cutting up to 1/4" thick Aluminum, 3/8" Stainless Steel and 1/2" Mild Steel.

Using the laser takes one-tenth the time of the former equipment. The typical job now takes from 3-15 minutes to process. Aluminum is cut at about 40 inches a minute for 1/8" and 15 inches a minute for 1/4". Steel usually runs at 60 inches a minute.

The Mfg S&T Center can now cut flat panels up to 2' by 2', and boxes up to 2' x 2' x 19" high. Larger panels can be cut with some file mirroring in the layout process.

The Center can also send electronically generated CAD files through a translator to convert them to the CNC (Computer Numerical Control) language that the laser understands.

With this new system, maintenance is minimal, with very little down time. Once a week technicians perform a three-minute lasing gas change and once a month they lubricate the table-positioning screws. Only occasionally do they have to align the laser beam through the delivery system.

Major customers of these systems include:

- 2663—Instrumentation Development
- 2665—Telemetry and Instrumentation
- 2666—Advanced Instrumentation Systems
- 2955—Test Equipment Design, Stockpile Surveillance
- 5914—System Technologies
- 10266—OTS Fleet Maintenance
- 14407—Information Systems and Test Engineering
- 15425—Missile and Flight Systems

Contact Don Davis, (505-845-8656, davis@sandia.gov)



MS&T's laser system reduces metal-cutting time by 90%.

Corey Campbell—Waste Technologist

The Mfg S&T Center has been growing and expanding its capabilities.

About a year ago, the Center management recognized a need for one full-time person to handle hazardous waste for the entire center. The goal was for this person to become familiar with the necessary regulations. On October 1, 2002, Corey Campbell was hired to fill this position.

Corey's work covers the installation and maintenance of the less-than-90-day waste area in the Advanced Manufacturing Processing lab. In addition, Corey visits other laboratories to collect the hazardous waste and transport it. His other duties include coordinating material destined for reapplication, validating the fire extinguishers monthly, and verifying that the shower and eye wash stations are fully operational weekly. Before coming to the Center, Corey worked for about four years as a contractor at the Radioactive and Mixed Waste Management Facility.

Outside of work, Corey likes camping, hunting, and fishing. He also enjoys being the spectator parent of two boys who wrestle.

Corey can be reached at 505-284-9154, cbcampb@sandia.gov



Corey Campbell

Insider News

Computer Applications for Manufacturing Department ISO9002/94 Registered

The Computer Applications for Manufacturing Department in the Mfg S&T Center is now ISO9002/94 registered as part of the SNL Manufacturing Enterprise. Registration ensures that the business management system is not only documented and auditable but also meets Sandia self-governance. ISO registration also meets DOE/NNSA expectations that manufacturing will use an acceptable alternative to QC-1 when performing WR work. When supporting NW-SBU with model-based manufacturing work, Computer Applications for Manufacturing is audited to QC-1 and ISO9002/94.

Within the Manufacturing Enterprise, processes are now in place for information services, network support, model

configuration management, and the information system infrastructure. This allows work with customers at whatever level of rigor they require for their product. Moreover, because processes are now documented, managed, followed, and controlled, the department can better assure quality to customers.

Contact Steve Baca, (505-844-3507, ssbaca@sandia.gov)

MS&T Receives Green Zia Award for its Environmental Management System

Energy conservation and waste reduction are the hallmarks of MS&T's environmental management system. MS&T won the prestigious New Mexico Green Zia Achievement Recognition for Environmental Excellence in 2002. The New Mexico Environment Department awards the Green Zia to companies and organizations that demonstrate commit-

ment to continuous improvement in environmental leadership. The members of this year's Environmental Management System Team are John Zich, Chad Hjorth, Craig Nimmo, Corey Campbell and Kristin Klossner.

Contact John Zich (505-845-8571, jlzich@sandia.gov)

(Insider News, continued on page 4)



Green Zia award ceremony (left to right) Chad Hjorth, John Zich, former Governor Gary Johnson, and Mick Gorospe.

Kudos

President's Quality Awards Gold

Matt Donnelly is a member of the Code Management Systems USEUCOM/USAFE Application Team that received a President's Quality Award at the Gold level in a ceremony on January 15th. The Code Management System represents a significant upgrade of use control systems for handling codes and keys. Matt was responsible for designing the graphite-epoxy resin composite packaging used in the system.



Matt Donnelly

Contact Matt Donnelly (505-845-9746, mwdonne@sandia.gov)

Silver

The Hot Pole Cracking Analysis Team, led by Pin Yang, was awarded a silver President's Quality Award for 2002.



Left to right, front: Mark Rodriguez, Pin Yang, Mike Hutchison, and Mark Stavig. Back: George Burns, Roger Moore, Chad Watson, and Tim Scofield.

Hot pole cracking of current stacks has been a persistent problem in Active Ceramics Production, because its cause was unknown. In this study, however, the team observed an unusual electric field-enhanced deformation near the phase-transformation temperature. This deformation has obviously contributed to production losses over the past few years.

This new but fundamental understanding has immediately boosted production yield from 68% to 95%, and led to a no-cost process change that eliminates the potential need for costly design change. For the first time, the current stack has built up a positive inventory. Benefits from this program will remain over the entire life span of Active Ceramics Production.

Contact Pin Yang (505-844-3386, pyang@sandia.gov)

Insider News (continued from page 3)

Effective Utilization of Space—a Hot Commodity

Mfg S&T has the second highest space costs across SNL. This is due to the nature of its business—manufacturing. The Center is equipment intensive, with prototyping and process development machinery occupying a large amount of space. Equipment may not be used for extended periods of time. Likewise, new equipment, whose installation has been delayed, is a candidate for storage.

Working with Facilities manager, Mick Gorospe, the Center acquired a building in Area IV for storage. The entire inventory of equipment stored at this site is reviewed on a yearly basis to determine its candidacy for property reapplication or sale. The acquisition of additional storage has allowed the Center to become more agile, by freeing valuable space within Center personnel-occupied buildings, for more effective utilization.

Contact Carla Chirigos (505-845-8645, cdchiri@sandia.gov)

Welcome New Employees

Saba, Antony W.	14111
Prevost, Guy E	14172
Thoma, Steven G.	14172
Forster, Mark P.	141812
Harmon, Roger L.	141812
Jones, Gregg K.	141812
Kumpunen, Mark A.	141812
Sanchez, Fred L.	141812
Barela, Jose O.	141813
Chavez, Bart D.	14184
Harris, Marc F.	14184

The MFG S&T Quarterly is published by a team of employees representing the MFG S&T Center. Contact any team member if you are interested in submitting an article or would like to know more about joining the team.

Carol Adkins	14100	845-9119
Carla Chirigos	14100	845-8645
Debbie Rimbort	14112	845-9557
Kim Archuleta	14171	284-5024
Howard W. Arris	14172	845-9742
Daryl Reckaway	14181	844-5705
Bernie Jokiel	14184	284-4285
Sharon Gordon	14186	844-9419
Julie Gibson	14192	844-7614

(Excellence, continued from page 1)

meeting with organizations to discuss the types of waste they create and the associated costs.

Environmental Management System Team:

This team helps management develop and document a system of continuous improvement in environmental operations. The team develops action plans to enhance Mfg S&T's procedures and to reduce environmental impact. The team, which meets once or twice a month, is looking for interested members. If you are interested in recycling, energy conservation, or quality management, contact John Zich (505-845-8571).

Help Reduce Environmental Impact at Work:

- Submit energy conservation, waste reduction and efficiency improvement ideas to your ES&H coordinator.
- Purchase items made of recycled and recyclable material whenever possible. Ask SNL's Purchasing organization to help you write purchase requests and contracts with "green" aspects built into them.
- Create or participate in an ES&H, energy, or water conservation team.
- Be an "Energy Nag" in your work area. Nags encourage people to turn off computers, lights, and other equipment when they're not in use. (http://www-irrn.sandia.gov/esh/p2/nag/nag_vol1num3.htm Check out this web site and see how only one person's efforts can create significant energy reduction.)
- Create or participate in environmentally-related teaching events at local schools
- Volunteer for activities involving local ES&H-related organizations
- Attend a class or event on health, safety, environment, sustainability, energy conservation, water conservation, waste management, waste reduction, or pollution prevention.
- Join a car pool, or ride the bus or your bike to work.

A final note on great energy-saving ideas: Try the new energy-saving power strips. These consist of an 8-outlet power strip with surge protection and a personal occupancy sensor. The sensor keeps controlled outlets on only when someone is present. Because computer monitors, task lights, and other plug loads often operate around the clock, this power strip ends the energy waste by turning these devices off when no one is using them. Check out SNL's Energy Management web site for more information.

Contact John Zich (505-845-8571, jlzich@sandia.gov)